

Claims

- [c1] 1.A process for conversion of hydrocarbon fuel to produce an exit gas stream containing hydrogen and carbon monoxide as main reaction products comprising:
providing a feed gas mixture comprising an oxygen containing gas and a heavy hydrocarbon fuel;
providing a catalytic structure comprising an oxidation catalyst and a steam reforming catalyst both supported on an open-channel support, the steam reforming catalyst being different than the oxidation catalyst; and
passing said feed gas mixture through said catalytic structure, said catalytic structure being maintained at a temperature sufficient to produce the exit gas stream containing hydrogen and carbon monoxide as main reaction products.
- [c2] 2.The process of Claim 1, wherein said hydrocarbon fuel is a heavy hydrocarbon fuel comprising a plurality of hydrocarbon molecules, with substantially all of said molecules each containing at least 6 carbon atoms.
- [c3] 3.The process of Claim 2, wherein said heavy hydrocarbon fuel is selected from the group consisting of gasoline, kerosene, jet fuel, and diesel fuel.

- [c4] 4.The process of Claim 1, wherein said oxidation catalyst is a noble metal.
- [c5] 5.The process of Claim 4, wherein said noble metal is rhodium.
- [c6] 6.The process of Claim 1, wherein said steam reforming catalyst comprises nickel.
- [c7] 7.The process of Claim 1, wherein said steam reforming catalyst further comprises rhodium.
- [c8] 8.The process of Claim 1, wherein said noble metal is rhodium and said steam reforming catalyst comprises nickel.
- [c9] 9.The process of Claim 1, wherein catalytic structure is maintained at a temperature greater than about 900°C.
- [c10] 10.The process of Claim 1, wherein said open-channel support comprises a ceramic monolith.
- [c11] 11.The process of Claim 1, wherein said open-channel support comprises a porous alumina monolith.
- [c12] 12.The process of Claim 1, wherein said feed gas mixture being essentially free of water.
- [c13] 13.The process of Claim 1, wherein said process de-

posits less than about 1 atom% of total carbon in said hydrocarbon fuel as elemental carbon and carbon-rich compounds.

[c14] 14.The process of Claim 1, wherein the catalyst contact time is from 10 milliseconds to 500 milliseconds.

[c15] 15.A method for supplying a product gas mixture comprising hydrogen and carbon monoxide to a solid oxide fuel cell system, said productgas mixture being produced by a conversion of hydrocarbon fuel, comprising the steps of:
providing a feed gas mixture comprising an oxygen containing gas and a heavy hydrocarbon fuel;
providing a catalytic structure comprising an oxidation catalyst and a steam reforming catalyst supported on an open-channel support, the steam reforming catalyst being different than the oxidation catalyst;
passing said feed gas mixture through said catalytic structure, said catalytic structure being maintained at a temperature sufficient to produce an exit gas stream containing hydrogen and carbon monoxide as main reaction products; and
directing said product gas mixture to said solid oxide fuel cell system.

[c16] 16.A reactor for converting of hydrocarbon fuel to an

exit gas stream containing hydrogen and carbon monoxide as main reaction products comprising:
a reactor shell having an inlet and an outlet and forming a reaction flow passage extending from the inlet to the outlet, the reactor shell also forming a catalytic reaction zone between the inlet and the outlet;
a catalytic structure disposed in the catalytic reaction zone comprising an oxidation catalyst and a steam reforming catalyst supported on an open-channel support, the steam reforming catalyst being different than the oxidation catalyst; and
a source of hydrocarbon fuel,
so that when a feed gas mixture comprising an oxygen containing gas and the hydrocarbon fuel is fed through the inlet, said feed gas mixture passes along the reaction flow passage and through said catalytic structure, said feed gas mixture converts in the catalytic structure to the exit gas stream containing hydrogen and carbon monoxide as main reaction products, and the exit gas stream discharges through the outlet.

[c17] 17. The reactor of Claim 16, wherein said hydrocarbon fuel is a heavy hydrocarbon fuel comprising a plurality of hydrocarbon molecules, with substantially all of said molecules each containing at least 6 carbon atoms.

- [c18] 18.The reactor of Claim 17, wherein said heavy hydrocarbon fuel is selected from the group consisting of gasoline, kerosene, jet fuel, and diesel fuel.
- [c19] 19.The reactor of Claim 16, wherein said oxidation catalyst is a noble metal.
- [c20] 20.The reactor of Claim 19, wherein said noble metal is rhodium.
- [c21] 21.The reactor of Claim 16, wherein said steam reforming catalyst comprises nickel.
- [c22] 22.The reactor of Claim 21, wherein said steam reforming catalyst further comprises cerium.
- [c23] 23.The reactor of Claim 16, wherein said noble metal is rhodium and said second catalyst is a steam reforming catalyst comprising nickel.
- [c24] 24.The reactor of Claim 16, further comprising a heater for heating the catalytic structure.
- [c25] 25.The reactor of Claim 16, wherein said open-channel support comprises a ceramic monolith.
- [c26] 26.The reactor of Claim 16, wherein said open-channel support comprises a porous alumina monolith.
- [c27] 27.A system for producing electric power comprising:

a reactor for converting of hydrocarbon fuel to produce an exit gas stream containing hydrogen and carbon monoxide as main reaction products; and
a fuel cell disposed for receiving the exit gas stream and consuming the hydrogen to produce electric power,
the reactor comprising:

a reactor shell having an inlet and an outlet and forming a reaction flow passage extending from the inlet to the outlet, the reactor shell also forming a catalytic reaction zone between the inlet and the outlet, a pre-reaction zone upstream of the catalytic reaction zone, and a post reaction zone downstream of the catalytic reaction zone;

a catalytic structure disposed in the catalytic reaction zone comprising an oxidation catalyst and a steam reforming catalyst both supported on an open-channel support, the steam reforming catalyst being different than the oxidation catalyst; and

a source of hydrocarbon fuel;

so that when a feed gas mixture comprising an oxygen containing gas and the hydrocarbon fuel is fed through the inlet, said feed gas mixture passes along the reaction flow passage and through said catalytic structure, said feed gas mixture converts in the catalytic structure to the exit gas stream, and the exit gas stream discharges through the outlet.